



## Broadband Access in Rural Indiana

### Introduction

The internet has become an essential component of everyday life in the United States. In fact, use of the internet for applications including entertainment, communication and social media, mobile health monitoring and fitness apps, and location and transportation services (Federal Communications Commission 2016a) has accelerated in recent years. From an economic standpoint, access to high-speed (broadband) internet connections can have far-reaching implications for communities. These include increased employment and business growth at the industry level (Whitacre et al. 2013), and expanded access by individuals to education and healthcare services (Shideler et al. 2007). While internet use and dependence exist in both urban and rural communities, rural communities continue to lag behind urban ones in terms of access to and adoption of broadband connections.

The purpose of this study is to assess differences in access to broadband services across Indiana's rural and urban areas. We begin by examining broadband access in the United States as a whole. Next, we compare national trends to those in Indiana, including data on broadband providers, connection speeds, and the variety of technologies available. Finally, we provide concluding remarks on the implications of broadband access for Indiana and offer strategies for accelerating rural broadband adoption in Indiana.

*Kevin Camp and Lionel J. Beaulieu*

*Department of Agricultural Economics and  
Purdue Center for Regional Development  
Purdue University*

### The Rural Indiana Issues Series

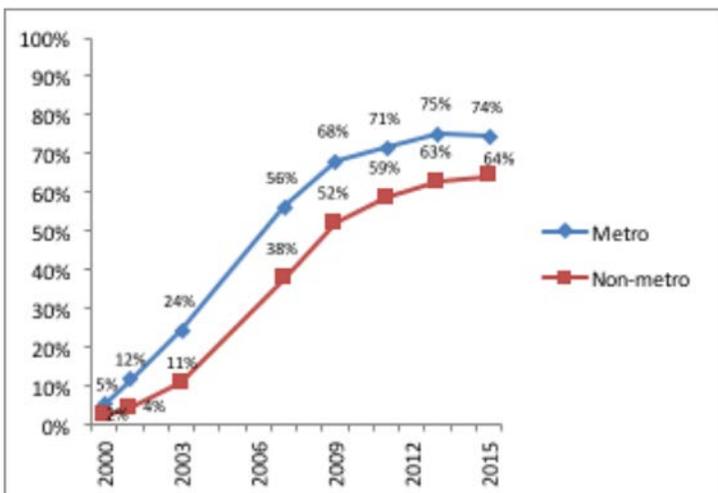
**Audience:** Local and state leaders who work with rural communities.

**Purpose:** To find data about issues of concern in rural communities and to interpret these data in meaningful ways to aid in decision-making.

**Method:** U.S. Census data analyzed across the county groupings—rural, rural/mixed, urban.

**Potential Topics:** Demographic changes, business development, health, health care, local government, taxes, education, agriculture, natural resources, leadership development, etc.

**Outcome:** Better, more informed decisions by rural decision-makers.



**Figure 1. Percent of U.S. households with access to broadband, 2000 to 2015**

Source: Brian Whitacre (Oklahoma State University), personal communication, April 21, 2016

## Broadband Access in the United States

Generally speaking, a rural-urban divide in broadband continues to exist in the United States. Figure 1 shows that although access has increased over time for both rural (nonmetro) and urban (metro) residents, the rural/urban disparity persists (a 10% gap in 2015). As Stenberg and coauthors (2009) note, at least two factors contributed to this gap. For one, broadband providers incur larger costs when offering service to areas with fewer residents. In addition, the physical challenge of installing cables in mountainous areas can be a setback for providers.

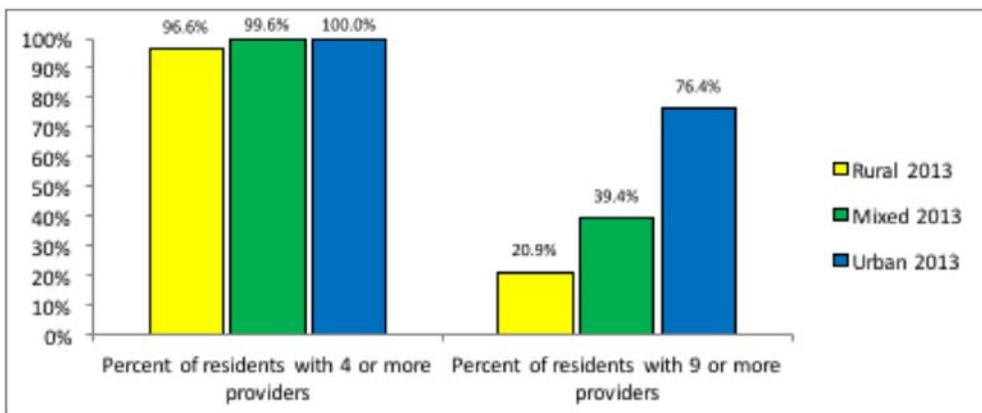
## Provision of Broadband in Rural and Urban Indiana

In order to analyze U.S. broadband access more thoroughly, we examine the provision of broadband services. In the absence of detailed data on the number of people purchasing broadband and the various market prices for service, the number of providers is one of the best proxies for assessing access (Stenberg et al. 2009). For purposes of this article, differences in the number of broadband providers help capture variations in high-speed internet access among counties in Indiana; counties with fewer providers have more limited access to broadband, and vice versa. Historically, a rural-urban gap in providers exists in the U.S., and evidence suggests it is growing over time (Stenberg et al. 2009). This national trend is evident across Indiana counties as well. A previous paper

in the Rural Indiana Issues Series (Ayres, Waldorf, and McKendree 2012) outlined thresholds for counties in Indiana based on three categories – rural, rural/mixed, and urban. We adopt these county-level definitions for the purposes of our study (for more information, refer to the Key Terms box).

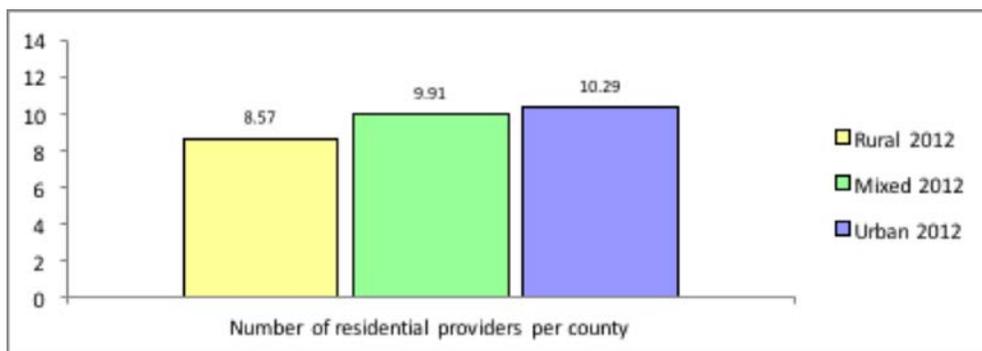
Figure 2 highlights broadband providers across the three county classifications. Rural, rural/mixed, and urban counties display similar levels of access when it comes to four or more providers. Specifically, the percentage of rural county residents with access to at least four providers is 96.6. For rural/mixed and urban counties, the figures are 99.6 percent and 100.0 percent, respectively. However, when the focus moves to residents with access to at least nine providers, the results vary greatly across rural and urban areas. Approximately 1 in 5 residents in rural counties of the state have access to at least nine providers. In rural/mixed counties, the proportion of residents with nine or more providers swells to 39.4 percent. By comparison, more than three-fourths (76.4 percent) of urban county residents have access to at least nine providers.

Figure 3 delineates the mean number of residential broadband service providers by county grouping in 2012. The data reveal that, among Indiana’s most rural counties, the average number of residential providers is roughly 8.6. Residents of rural/mixed counties can choose from around 9.9 different residential providers on average, while those living in urban counties can choose from an average of nearly 10.3. Hence, urban counties tend to have slightly more service providers relative to rural and rural/mixed counties<sup>1</sup>.



**Figure 2. Number of broadband providers by rural, rural/mixed, and urban Indiana residents, 2013**

Source: Authors’ calculations based on U.S. Census Population Estimates 2013 and broadbandmap.gov 2013.



**Figure 3. Number of residential broadband providers per rural, rural/mixed, and urban counties, 2012**

Source: Authors’ calculations based on Federal Communications Commission (2013).

Figure 4 builds on the information captured in Figure 3 by including 2013 data on residential broadband providers. In general, the average number of residential service providers across all three county groupings has expanded. The number of broadband providers per county in rural parts of the state has risen from 8.6 in 2012 to 9.2 in 2013, amounting to a percent change of +7.5%. The rural/mixed percent change is +8.6%, and the urban percent change is +11.5%. The relatively larger urban percent change suggests the urban-rural gap in the average number of broadband providers from which residents can choose continues to grow. But, of these 2012 to 2013 percent changes, only that associated with rural/mixed counties was found to be statistically significant at the 90% level of confidence. This means we cannot safely conclude that rural or urban counties experienced year-to-year increases in the number of providers. However, in 2013, overall rural-urban discrepancies appeared to persist. Mean-comparison testing of the values in Figure 4

revealed the difference between the rural and urban averages was significant at the 99% level of confidence, as was the difference between the rural and rural/mixed averages. Once again, the difference between the rural/mixed and urban averages was not statistically significant.

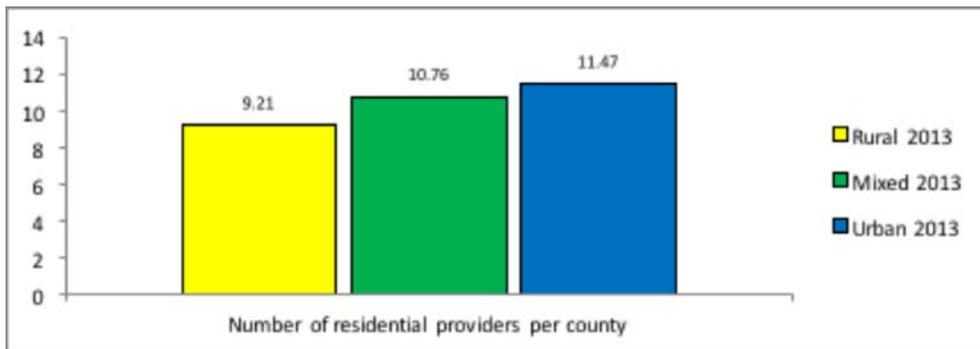
Overall, the data suggest that rural areas in Indiana are still lagging behind their urban county counterparts when it comes to access to a wide array of basic level broadband providers. However, additional information can further illuminate discrepancies between rural and urban areas.

A key issue worth consideration is the speed of available broadband connections. A recent study (Akamai 2015) finds the average connection speed in the United States stands at 12.6 Mbps, while the median speed is 3.0 Mbps (Communications Workers of America 2010). In Indiana, connection speeds advertised by broadband providers vary greatly. Figure 5 plots the percentage of residents in each of our three county groupings with access to certain broadband speed levels in 2013.<sup>2</sup> The figure assesses broadband availability at three different maximum advertised download speeds. The “low” category refers to download speeds greater than 3 Mbps (much lower than the national average). Slightly lower percentages of rural and rural/mixed residents have access to speeds greater than 3 Mbps, but all three county groupings are at or near 100 percent coverage.

The “medium” speed category reflects access to download speeds greater than 10 Mbps (slightly lower than the national average). Both rural/mixed and urban residents have access to these speeds. However, in the most rural counties, access is available to a slightly lower share of their population (94.6 percent). Finally, the “high” speed category refers to download speeds greater than 1 Gbps, nearly 80 times faster than the national average of 12.6 Mbps. Only 18.4 and 25.6 percent of rural and rural/mixed residents, respectively, have access to high-speed connections of this nature. But a much larger proportion (76.4 percent) of urban residents is able to secure broadband service from providers that claim the capability of delivering broadband services at these high connection speeds.

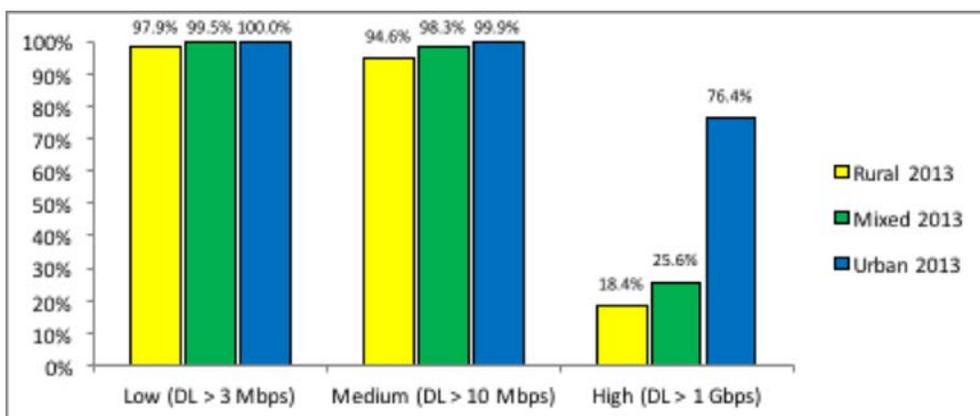
The mix of broadband technologies and the variations among them are important elements to explore when studying broadband access. In particular, differences between wireless and wireline broadband technologies are worthy of investigation. There is evidence that broadband providers have begun to focus on increasing their offerings of wireless services relative to wireline services (Ridoux et al. 2006). As Figure 6 shows, this appears to be the case in Indiana given the generally lower levels of access to wireline technology versus wireless, regardless of residents’ county groupings. Furthermore, similar proportions of Indiana residents have access to wireless technology, irrespective of their rural-urban status. Wireless coverage is approaching 100 percent

for Indiana residents living in the three county categories. On the other hand, differences across the groupings are observed for wireline access. In rural Indiana, 86.6 percent of residents have wireline connections available. The figure swells to nearly 96 percent for individuals residing in mixed/rural areas, while virtually all residents of urban counties (99.4 percent) have the capability to access wireline broadband. This finding is important given that traditional wireline technologies offer higher speeds relative to wireless technologies (Ridoux et al. 2006).



**Figure 4. Number of residential broadband providers per rural, rural/mixed, and urban counties, 2013**

Source: Authors’ calculations based on Federal Communications Commission (2014).



**Figure 5. Broadband connection speeds by rural, rural/mixed, and urban Indiana residents, 2013**

Source: Authors’ calculations based on U.S. Census Population Estimates 2013 and broadbandmap.gov 2013.

### Broadband Adoption in Rural and Urban Indiana

Analyzing data on the provision of access to broadband connections is informative, but fails to answer a fundamental question regarding the rural broadband story: “Are rural residents *adopting* broadband at the same rate as urban residents?” Research by Whitacre and his co-authors (2014) suggests that broadband **adoption** is far more important than **access** to spurring economic growth at the county level. In particular, counties with high internet adoption rates realize higher median

income growth and lower unemployment growth relative to those with lower rates of internet use, including nonmetropolitan counties.

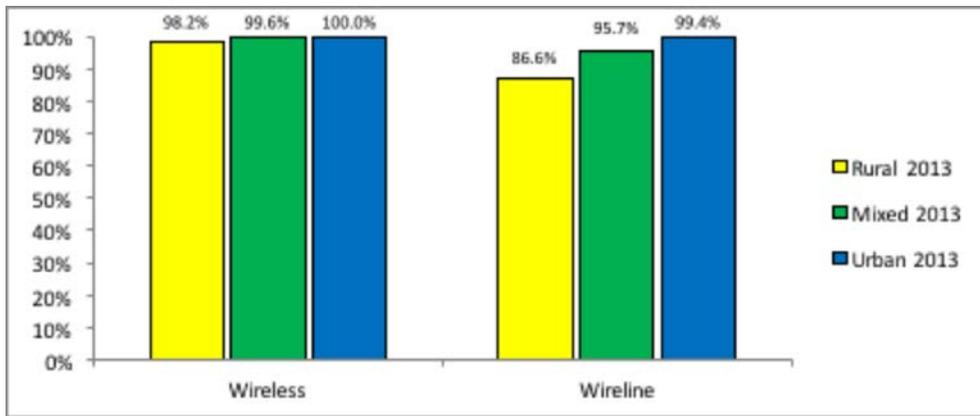
Figure 7 highlights broadband adoption rates for Indiana households (HH) based upon their place of residence (rural, rural/mixed, or urban) and categories of internet connection levels. The five categories on the y-axis refer to the number of internet connections over 200 kbps in at least one direction per 1,000 HH. They are defined as follows: Category 1 = 1 to 200 broadband connections per 1,000 HH; Category 2 = 201 to 400 broadband connections per 1,000 HH; Category 3 = 401 to 600 broadband connections per 1,000 HH; Category 4 = 601 to 800 broadband connections per 1,000 HH; and Category 5 = more than 800 broadband connections per 1,000 HH. Hence, a higher category means a greater level of adoption. Indiana's 92 counties were assigned a value ranging from 1 to 5. Next, counties were grouped into their appropriate county typology, namely, rural, rural/mixed, and urban. The bubbles in Figure 7 reflect the percentage of counties in each county grouping (i.e. rural, rural/mixed, or urban) having specific internet connection levels. Thus, the larger the size of the bubble, the greater the proportion of counties with connection speeds falling into that category. As the chart indicates,

no county type falls into the lowest connection category. However, rural counties in the state are more likely to have in the range of 401 to 600 broadband connections per 1,000 HH. Around a quarter of rural/mixed counties belong to Category 3 (401 to 600), while the majority of the remainder belongs to Category 4 (601 to 800). As for urban counties, more than 70 percent have between 601 and 800 connections per 1,000 HH, with another 23.5 percent falling into the highest broadband adoption category (more than 800 connections per 1,000 HH).

Figure 8 tracks the percentage of counties (rural, rural/mixed, and urban) that fall into categories of higher speed connections (at least 3 Mbps downstream and at least 768 kbps upstream). Aside from referring to faster connections, the categories on the y-axis are identical to those in Figure 7. The bubbles refer to the percentage of counties in each county grouping type that falls into each category (a larger bubble signifies a relatively larger percentage of counties). In this case, the data reveal that urban areas in the state also have the best rates of adoption of higher speed broadband connections. Specifically, the majority of urban counties (52.9 percent) have between 601 and 800 high speed connections per 1,000 HH, whereas the adoption of high speed broadband for a majority of rural counties is between 201 and 400

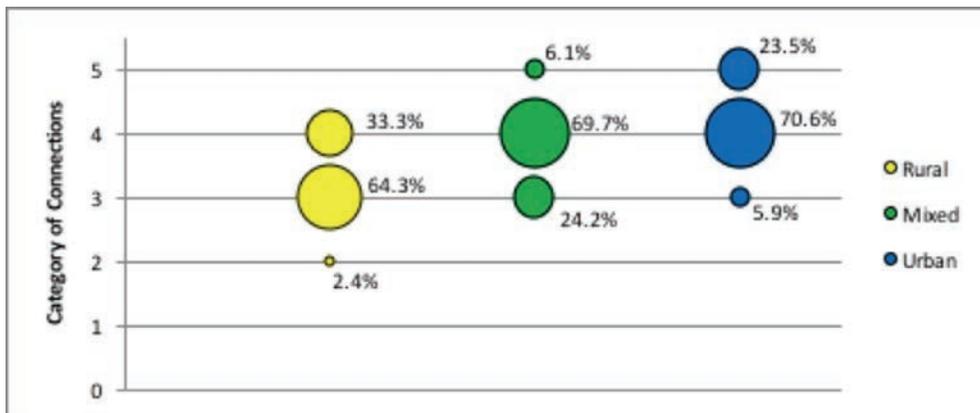
HH (64.3 percent). Certainly, the issue at hand may be one of access since the penetration of high-speed broadband services is greatly reduced in rural areas of the state. Also important is the matter of cost, owing to the fact that it is more costly to deliver such services to more sparsely populated areas.

When studied in tandem, Figures 7 and 8 make clear that urban residents of Indiana are both more likely to adopt broadband connectivity and more inclined to adopt the highest broadband connection speeds.



**Figure 6. Wireless vs wireline access by rural, rural/mixed, and urban Indiana residents, 2013**

Source: Authors' calculations based on U.S. Census Population Estimates 2013 and broadbandmap.gov 2013.



**Figure 7. Rural, rural/mixed, and urban Indiana counties' broadband adoption levels, 2014**

Source: Authors' calculations based on Federal Communications Commission (2016b).

## New Federal Communications Commission Broadband Benchmark Speeds

In early 2015, the Federal Communications Commission (FCC) revised its benchmark speeds for broadband internet, increasing them from 4 Mbps/1 Mbps (download/upload) to 25 Mbps/3 Mbps.<sup>3</sup> The revision came about as a result of FCC's changing conception of the speeds that would be required for most modern internet usages (e.g. high-quality videos, data, and voice applications) to function properly (Federal Communications Commission

2015). This major shift of what FCC labels as an acceptable level of broadband capacity is likely to accelerate the need to invest in a 21<sup>st</sup> century internet infrastructure across the United States. In light of the new FCC recommendations, it is important to determine the extent to which counties in the state have access to internet services with speeds of this magnitude. The results of our analysis are captured in Figure 9. It reveals the percentage of residents in each county grouping who lack access to internet connections of the speed outlined in the new FCC guidelines. Only 7.2 percent of urban county residents in Indiana are unable to access providers that are capable of delivering broadband that match the new FCC speeds. By contrast, roughly 25 percent of rural/mixed county residents and 50.8 percent of rural residents fail to have access to services that align with the new guidelines. In other words, nearly one-fourth of rural/mixed residents, and just over half of rural residents, have no access to the level of internet service that the FCC now states is the benchmark for high-quality residential broadband service in the U.S. Certainly, this represents a major hurdle for rural Indiana residents and businesses that see a critical need to gain fuller access to dependable high-quality broadband connections for a host of important services and resources – many of which are needed to attract and retain quality jobs and talented workers.

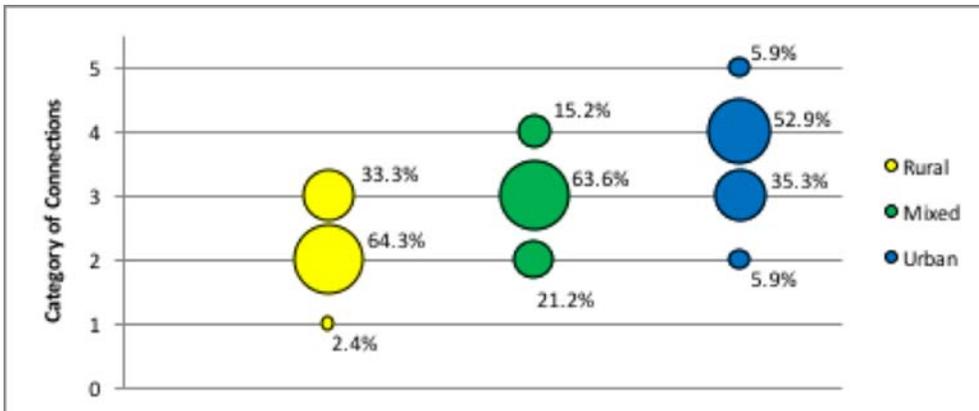
### Conclusion

Broadband access has important implications for rural areas in Indiana. For one, the internet can play an important role in social interactions among rural people. Such interactions have the potential to increase the sense of community in a rural place, thereby reducing outmigration (Stenberg et al. 2009). But broadband access has other implications for rural areas, including strategies to expand provision of healthcare services and retain existing businesses (Waldorf et al. 2013). For example, rural facilities depend on broadband connections for timely access to electronic medical records. Moreover, broadband allows rural people the opportunity to engage in telehealth practices such as distance monitoring and ordering prescriptions remotely. Telehealth is likely to be more vital for rural people who typically have fewer options for securing face-to-face healthcare services. In addition, home and small business advancement are important outcomes that are possible with increased broadband provision. The development and survival of both small and home-based businesses can improve rural economies (Stenberg et al. 2009).

Financial and technical assistance resources are available at the national level to increase rural broadband provision, via the U.S. Department of Commerce’s BroadbandUSA Access: Connecting

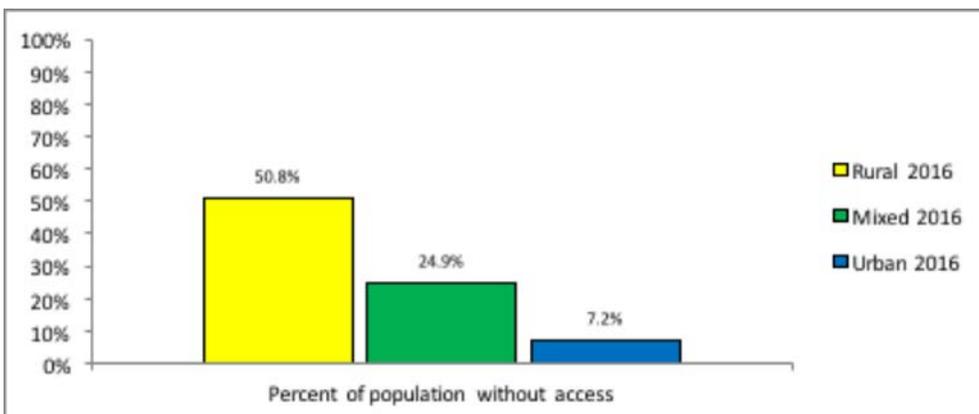
America’s Communities program and the U.S. Department of Agriculture’s Community Connect programs. Additionally, the role of rural power cooperatives in providing broadband has grown recently in some regions of the country. Co-ops are able to leverage their existing systems of infrastructure and maintenance, and they stand to receive increased funding from the FCC’s Rural Broadband Experiments (Kang 2016).<sup>4</sup>

While these methods of increasing provision show promise, it remains the case that enhanced access alone is insufficient to spur the growth of rural economies. Whitacre and his associates (2014) find in favor of broadband adoption’s importance for rural counties, and they conclude that counties with higher available download speeds tend to experience both lower rates of poverty and attract increased proportions of creative class workers. Unfortunately, both adoption rates and download speeds are the two areas where rural Indiana counties are at a greater disadvantage relative to their urban counterparts (see Figures 5, 7, 8, and 9). In particular, the low percentage of rural Indiana residents who are afforded access to broadband speeds meeting the FCC’s 2015 broadband benchmark (Figure 9) is a



**Figure 8. Rural, rural/mixed, and urban Indiana counties' high speed broadband adoption levels, 2014**

Source: Authors' calculations based on Federal Communications Commission (2016b).



**Figure 9. Percentage of population without access to download speeds of 25 Mbps, upload speeds of 4 Mbps by rural, rural/mixed, and urban Indiana counties, 2016**

Source: Authors' calculations based on Federal Communications Commission (2016a).

matter that deserves the attention of policymakers at local, state, and federal levels. If no effort is made to reduce the disparities in internet speeds between rural and urban areas of the state, then the state's rural areas will continue to be hard pressed to attract and retain talented and creative workers, or be able to recruit or retain businesses that are increasingly dependent on high-speed broadband services to carry out activities that are vital to their economic growth and survival.

Finally, a recent announcement by the Indiana Office of the Governor calling for expansion of broadband coverage to rural areas of the state could be a step in the right direction. In a nutshell, the plan calls for the state to lease its network of towers to a private sector firm – a company that will then utilize these towers to accelerate broadband access to rural Indiana. While promoting access is important, so too is the need to deliver educational programs that promote the effective use of broadband by a variety of rural-based entities. In our view, tapping the community/ economic development resources of Purdue University Extension and other higher-education institutions in the state would be a smart move. Working in partnership, these educational institutions could develop and deliver a cohesive set of programs and technical assistance activities that could expand the application of broadband by agriculture, small businesses and communities in rural Indiana.

## References

- Akamai. (2015). "State of the Internet Q3 2015 Report." <https://www.akamai.com/us/en/multimedia/documents/state-of-the-internet/akamai-state-of-the-internet-report-q3-2015.pdf>.
- Ayres, J., B. Waldorf, and M. McKendree. (2012). "Defining Rural Indiana—The First Step." EC-776-W. <http://www.extension.purdue.edu/extmedia/EC/EC-766-W.pdf>.
- Communications Workers of America. (2010). "Speed Matters: A Report on Internet Speeds in All 50 States." <http://www.speedmatters.org/2010report?nocdn=1>.
- Federal Communications Commission. (2013). Internet Access Services: Status as of December 31, 2012. <http://transition.fcc.gov/wcb/iatd/comp.html>.
- (2014). Internet Access Services: Status as of December 31, 2013. <http://transition.fcc.gov/wcb/iatd/comp.html>.
- (2015). 2015 Broadband Progress Report And Notice Of Inquiry On Immediate Action To Accelerate Deployment . [https://apps.fcc.gov/edocs\\_public/attachmatch/FCC-15-10A1.pdf](https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-10A1.pdf).
- (2016a). 2016 Broadband Progress Report. [https://apps.fcc.gov/edocs\\_public/attachmatch/FCC-16-6A1.pdf](https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf).
- (2016b). Form 477 County Data on Internet Access Services: As of 12/31/14. [https://www.fcc.gov/sites/default/files/county\\_map\\_dec2014.zip](https://www.fcc.gov/sites/default/files/county_map_dec2014.zip).

## Footnotes

1. Mean-comparison tests revealed the difference between the rural and rural/mixed averages to be significant at the 99% level of confidence, and the difference between the rural and urban averages to be significant at the 95% level of confidence. The difference between the rural/mixed and urban averages was not statistically significant.
2. These calculations are based on maximum download and upload speeds advertised by broadband providers. The actual speed of a given internet connection depends on additional factors, such as network congestion and the capacity of the computer used to access the internet. For more information, see <http://www.broadbandmap.gov/classroom/download-upload>.
3. See <http://www.fcc.gov/reports/2015-broadband-progress-report>.
4. However, legal hurdles – such as the Supreme Court's ruling in National Cable & Telecommunications Ass'n v. Brand X Internet Services in 2005 – have the potential to inhibit cooperatives' ability to provide broadband services.

## Key Terms

**Provider:** an entity that furnishes internet access service to individuals

**Wireline:** broadband service from a fixed home connection (e.g. DSL, cable modem, optical carrier/fiber to the end user, broadband over power lines)

**Wireless:** broadband service, either mobile or fixed, that is provided via a radio link between the user's location and the provider's facility (e.g. mobile data, satellite broadband)

**Rural Indiana County:** any Indiana county with a total population less than 30,000, population density less than 78 people per square mile, and with a largest city of fewer than 10,000 people

**Rural/Mixed Indiana County:** any Indiana county with a total population between 30,000 and 100,000, population density between 78 and 200 people per square mile, and with a largest city of between 10,000 and 30,000 people

**Urban Indiana County:** any Indiana county with a total population more than 100,000, population density more than 200 people per square mile, and with a largest city of greater than 30,000 people

## Common Broadband Speed Measures

**Mbps:** megabits per second; with a 1 Mbps connection, a typical user will be capable of downloading

a book (size 1 megabyte) in 8 seconds,

a song (size 4 megabytes) in 32 seconds, and

a movie (size 6144 megabytes) in 13 hours and 39 minutes

**Gbps:** gigabits per second

1 Gbps = 1,000 Mbps

**kbps:** kilobits per second

1,000 kbps = 1 Mbps

- Kang, C. (2016). How to Give Rural America Broadband? Look to the Early 1900s. *The New York Times*. Retrieved August 26, 2016, from [http://www.nytimes.com/2016/08/08/technology/how-to-give-rural-america-broadband-look-to-the-early-1900s.html?emc=eta1&\\_r=0](http://www.nytimes.com/2016/08/08/technology/how-to-give-rural-america-broadband-look-to-the-early-1900s.html?emc=eta1&_r=0).
- Ridoux, J., Nucci, A., & Veitch, D. (2006). Seeing the Difference in IP Traffic: Wireless Versus Wireline. In: IEEE Infocom.
- Shideler, D., Badasyan, N., & Taylor, L. (2007). The Economic Impact of Broadband Deployment in Kentucky. *Regional Economic Development*, 3(2), 88-118.
- Stenberg, P., Morehart, M., Vogel, S., Cromartie, J., Breneman, V., & Brown, D. (2009). "Broadband Internet's Value for Rural America." U.S. Department of Agriculture, Economic Research Service.
- Whitacre, B., Gallardo, R. & Strover, S. (2013). Rural Broadband Availability and Adoption: Evidence, Policy Challenges and Options. National Agricultural & Rural Development Policy Center (NARDeP).
- (2014). Broadband's Contribution to Economic Growth in Rural Areas: Moving Towards a Causal Relationship. *Telecommunications Policy*.



## About the Authors

Kevin Camp received his Master's degree in 2015 from the Department of Agricultural Economics at Purdue University and currently serves as adjunct assistant professor at Sacramento City College and Cosumnes River College in California. Lionel J. Beaulieu is Director of the Purdue Center for Regional Development and Professor in the Department of Agricultural Economics. His expertise is in community/rural development, and he has overseen a number of national research and Extension programs, including the National e-Commerce Extension Project, and the eXtension rural entrepreneurship effort.

For further information, please contact Dr. Beaulieu at [ljb@purdue.edu](mailto:ljb@purdue.edu).

September, 2016

It is the policy of the Purdue University Cooperative Extension Service that all persons have equal opportunity and access to its educational programs, services, activities, and facilities without regard to race, religion, color, sex, age, national origin or ancestry, marital status, parental status, sexual orientation, disability or status as a veteran. Purdue University is an Affirmative Action institution. This material may be available in alternative formats.

